LECTURES

(Delivered at the Mechanics Institution, 19th Dec., 1831, and 13th Feb., 1832,)

ON

CARBON, OXYGEN, AND VITALITY,

THE THREE GREAT AGENTS IN

THE PHYSICAL CHARACTER OF MAN.

WITH REMARKS ON

ASIATIC CHOLERA.

BY

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TO SIR WILLIAM RUSSELL, BART.

SIR,

At a period like the present, when private interest and public prejudice have combined to depreciate the character of Medical practitioners, it is of importance to an Author, to obtain the patronage of one, whose high integrity places him beyond the reach of suspicion: this doubles the obligation I am under, in being permitted to dedicate these Lectures to you.

That a disease of a singular and malignant character, has recently made its appearance in this Country, is a fact confirmed by the most respectable authority; but, it is you, Sir (" to whom all by acclamation have conceded the pre-eminence") to whom we are principally indebted, for that intelligence, which, by arousing our attention, has given us the opportunity of adopting such measures, as are best calculated to mitigate its effects.

With profound respect for your private worth, and professional abilities,

I am, Sir, your most obedient,
And devoted Servant,
George Rees.

Clapham Rise,
March 12*th*, 1832.

LECTURE I.

Ladies and Gentlemen,

Though an accurate knowledge of the nature and treatment of the various diseases to which the human body is liable is considered as peculiarly appropriated to one distinct class of the community, yet, as it is a subject in which every individual must feel that he is personally concerned, it is both reasonable and natural to suppose that he should deem it deserving of some share of his attention.

The mind of Man is naturally inquisitive: not content with the investigation of those objects which more immediately surround him, he directs his enquiring eye beyond the narrow limits of his own terrestrial habitation; he not only views the Works of Nature with diligence and delight, but labors to discover the secrets of her operations; he looks from effects to causes, and from causes to effects, that "by drinking at the fountains of knowledge he may quench the thirst of curiosity."

Such is the aspiring character of man; and, when we look to the knowledge which he has already acquired, it must be confessed that the labors of his research have been abundantly recompensed by the importance of his discoveries:—He has made the earth subservient to his purpose by imparting fertility to the soil, can calculate with unerring certainty the movements in his own planetary system, can travel the ocean from pole to pole, and last, but not least, can analyse and re-combine the atmosphere in which he breathes, thus triumphing over difficulties apparently superior to his strength, and bringing the very elements in some measure in subjection to his authority.

Is it to be supposed, then, that a being whose mind is so excursive and inquisitive can be indifferent to those operations which more immediately surround him, or that he will be inactive or inanimate, when his own personal safety is concerned, when his very existence is in danger, and death is at his door? On such an occasion, and that occasion has now occurred, it is the duty of every man, to bring his abilities into action,—to guard against the danger that surrounds him, and to adopt such precautionary measures as may be most befitting to meet the approaching calamity.

Let it not be supposed, that in speaking as I now do in reference to a disease which, it is said, has recently made its appearance in this country, that I wish to quicken your attention, by working upon your fears; these fears are already, in my humble opinion, in many instances much greater than the occasion demands, and he that is intimidated without cause will probably act without reason; but there is such a thing as salutary fear—to be utterly fearless, when danger is at hand, implies a lack of understanding, and would lead to the neglect of those means which are essential to safety.

To come then more immediately to the subject which it is our present business to consider:—

A disease of a most malignant character, singular in its symptoms, rapid in its progress, and destructive in its operation, has for a long time been extending its ravages over a great part of the habitable world. I will not waste your time, nor fatigue your attention, by tracing its progress from country to country, or from year to year; the limits of a lecture compel me to reject every thing which is not essential to my purpose, but some slight reference to the subject is indispensable, as there are certain facts, connected with its history, which are perfectly incompatible with the theories that have been offered to explain it; there is likewise a degree of satisfaction in an allusion to facts, which are not liable to contradiction, to facts which are independent of hypothesis, and which are recognized by all parties as incontrovertible truths.

It is a fact, then, that the disease originated in India, at Jessore, the capital of the Sunderbunds, a place about 70 miles from Calcutta; and, from the localities of this situation, it was natural to suspect, that the *malaria* of the country was quite sufficient to produce the disease; that it aggravated the disease, there can be no doubt,—that the effluvia of the soil, and the temperature of the climate, combined their pernicious influence in imparting malignity to the poison, there can be no reasonable ground to disbelieve, and we may derive no small consolation from the conviction, that as we live in a more cultivated soil, as well as a more temperate climate, where the principles of cleanliness and ventilation are better practised, and much better understood, the disease, if it prevail at all, will not come with that unrelenting severity, which it has been the fate of other countries to experience.

Dr. Kennedy, whose work on the history of contagious Cholera will amply repay the labor of the perusal, represents Jessore "as crowded, dirty, and ill-ventilated, surrounded by a thick jungle, and exposed during the rains to the effluvia of an immense quantity of stagnant water. The district of which it is the capital is composed of the Sundurbunds, a name given to numerous low marshy islands, contained in the Delta of the Ganges, and formed by the different channels through which that river travels to the ocean. The Sunderbunds are overgrown with wood, and inhabited only by tygers, reptiles, and such other denizens of the wilderness."

Speaking of Calcutta, also, he says, "the native town is chiefly composed of miserable lanes, narrow, dirty, and unpaved, and the majority of the dwellings are low huts with sidewalls built of mud, mats, and bamboos, and covered with small tiles. Amidst the swarming population of these filthy receptacles, in which all descriptions of disgusting animal and vegetable odours abound, the distemper ran a long and wide career of destruction. Barely existing on a meagre diet of bad rice, the poor workmen who had been abroad all day, pursuing their laborious avocations in the sun, returned to their houses in the most fitting state of body to contract the disease; exhausted by the heat and fatigue, and confined during the night with their families, often six or eight in number, in a small space to which fresh air was a stranger, they were attacked by Cholera in hundreds, and a frightful proportion of those attacked were swept away in the lapse of a few hours."

From all these circumstances it was very natural to infer that the localities of the situation were sufficient to account for the disease; and, had it been confined to the territory of Bengal, there would have been good ground for the opinion, for this is for the most part a low, flat, marshy country, subject to inundations, and consequently to exhalations, which generate a disease endemial to the country, commonly called the *Bengal remittent fever*, but this is totally different in its character from that which we are now about to consider: the Bengal remittent fever is similar to the intermittent fever of this and other countries; it is the same in Kent, as in Essex, in England, as in Holland, on the banks of the Ganges, and the swamps of the Havannah; it is the one identical disease, only modified in its appearances by the peculiarities of climate and constitution; it is the effect of that particular exhalation called Marsh miasmata, which there is reason to believe is carbureted hydrogen gas. *This* disease is not contagious, and only affects those who come within the sphere of its influence, and is sometimes very circumscribed. It is true, persons who live at a given distance from the spot may contract the disease, provided a current of air set in to waft the contaminated atmosphere in that direction; but it never travels against the wind, nor does it rise beyond a certain point of elevation.

But this new disease seems to bid defiance to all general laws, and to trample over all natural impediments; it is not confined to flat countries, not checked in its progress by the resistance of the winds, not limited to any peculiar soil, nor extinguished by any particular temperature, but has spread in every direction, baffling the calculations of the wise, and exciting the consternation of the timid.

It commenced at Jessore in the month of August, 1817, and here the consternation was so great that the inhabitants fled from the spot, as if they had been flying from a serpent; here the disease was so dreadful that, in the course of a few weeks, ten thousand of the inhabitants were the victims of its fury. From Jessore, it extended in a short time to Calcutta, where it raged with undiminished severity, and thence it spread in every direction throughout the province of Bengal; but here we must notice one remarkable circumstance:—

In pursuing the track of its devastations, we do not find it moving from place to place, or from town to town, in strict conformity to the proximity of their situation, but, with a sort of capricious peculiarity, skipping over places immediately contiguous to its operations, and starting up suddenly at remote distances, returning however, as if to atone for its neglect, to those places which it seemed to have overlooked. And here we must point out another feature of the disease, as it may have some little influence in determining the important controversy respecting its contagious character. It did not always adhere to the principles of locomotion, but broke out at different points at the same time. I mention the fact without making any commentary on it at present.

From Calcutta it extended to Moorshedabad, Musseffapore, Patnah, and Ballasore. Pursuing the course of the Ganges and its tributary streams, it reached the interior of the country, and on the 6th of November a most remarkable eruption took place in the grand army then stationed in Bundlecund, on the banks of the Sinde, a tributary of the Jumma; here it acted with the rapidity of an electric shock: the men fell from their horses, as if they had been smitten by an invisible hand; 5000 perished in five days, and the road was strewed with the dying and the dead.

I need not track its progress, in minute detail, through the different towns of Banda, Hutta, Saugur, Ougien, and Kotah, though it may be remarked that in Kotah, which is situated upon a solid rock, its effects were so fatal that the inhabitants fled from the spot; nor will it be necessary to enumerate individually the places which have subsequently been visited by this *Morbus maximè terribilis.*

I hasten to abridge this part of the subject by stating that, after spreading terror and desolation throughout the extensive territory of Hindostan, and crossing the Himalaya Mountains, it invaded the empire of China, where, it is impossible to form an estimate of the dreadful ravages which it probably made in the crowded population of that extensive country : the fact of its having crossed the Himalaya Mountains it is our duty to mention, though it is not in our power to explain—it may tend to check the pride of philosophy, and subdue the presumption of hypothesis, which would have been likely to have assigned these as the insurmountable limits of its career.

When I say it crossed the Himalaya Mountains, I do not mean to assert 'that it travelled like an invading army from one side to the other : perhaps the same change in the atmosphere which produced the disease in one place may have taken place in another, and *that* I think the most feasible hypothesis.

To sum up all then that it is necessary to say on this part of the subject, the disease has not only extended to China, Russia, Persia, and Poland, but after visiting Germany, Prussia, and Hamburgh, has at last landed on the British shore.

But what is this disease? for I have not yet ventured to give it a name, and the name which has been given to it I adopt, not from choice, but from necessity—it has been called *Cholera;* and, before I proceed farther, I must take the liberty to make a few remarks on the impropriety of the expression, not that I wish to waste time in verbal criticism, but because it is of vital importance, in investigating the disease, not to be misled by the absurdity of the expression.

The term "Cholera" involves a principle, but the principle is repugnant to the disease; the term Cholera signifies a flow of bile, but the *want* of bile is one of the most prominent peculiarities of the complaint; it is impossible, therefore, to use the word "Cholera" without pointing out the absurdity of an expression which literally implies, *not* what it is, but what it is *not.* There is another remark, which I think it may be seasonable to introduce here: Cholera morbus, I mean that which is so called in all our systems of nosology, is a disease which every medical man does, or ought to, understand; it is a disease, not of foreign importation, not attributable to atmospheric influence, not pestilential or universal, not generated exclusively in foreign climates, but endemial in our own; it ranks as one of the ordinary autumnal diseases, which we are always disposed to anticipate as the summer recedes – a disease which, Sydenham says, is as certain as the cuckoo in the spring, a disease as different in its causes and its consequences from what we now denominate Asiatic cholera as any two diseases that affect the general health; yet who would not naturally suppose, from the application of the term, that the Asiatic cholera was only an aggravated condition of the same complaint? If, therefore, we are under the necessity of adopting the phrase, it is at any rate incumbent upon us to point out the distinction, that we may not be misled by the perversion of language.

With regard to the common cholera morbus, as it may be called, though that is not exactly the subject of this Lecture, I shall beg leave to offer a few observations, in order, in the first place, that you may be the better enabled to make the distinction, and because it will afford me the opportunity of illustrating the principles which I shall hereafter communicate, by a reference to the disease; and, though I cannot presume to suppose that the greater part of those whom I have now the honor to address are not more deeply acquainted with the science of physiology than myself, I must claim their indulgence for a few minutes, in bringing to their recollection some facts with which they are already familiar, in order to justify the inferences I am about to draw.

I must begin with observing that, the Liver is a large and important organ, situated in the cavity of the abdomen, destined to the secretion of bile, and that the blood from which this bile is secreted is *venous*, not *arterial* blood; this is a striking peculiarity with regard to the function of the Liver. I consider it one of the established laws of the animal œconomy, from which there is no exception, that bile is secreted from venous blood; and I lay some stress upon the proposition, because some years ago Mr. Abernethy fancied he met with an instance where bile was secreted from blood conveyed by the hepatic *arteries.* Now I deny the possibility of the fact, and am astonished that such an eminent physiologist could, from any peculiarity in the distribution of blood vessels, be led to a conclusion so repugnant to reason; as well might a person suppose if there were two tubes placed together, the one throwing out milk and the other water, that both proceeded from the same source; the tubes may approximate certainly, they may be in actual contact, but the fountain from which they are supplied must be different,—this I hold to be a legitimate conclusion; the fact is, that arterial blood does not contain the principles necessary to the formation of bile; we know that the blood in the veins is of a dark color, and we likewise know, for chemistry has ascertained the fact, that the dark color of venous blood is owing to a quantity of carbon which enters into its composition.

After the blood has been circulated through the system it becomes deteriorated in its qualities, and would be unfit for the purposes of the animal œconomy, if it were not renovated and improved, by coming in contact with atmospheric air, through the medium of the lungs. I suppose it is not necessary to resort to argument to prove that, if you cannot breathe, you will die: this is a self-evident proposition.

When the blood is conveyed to the lungs, it is of a dark black color; but, when it has undergone the process of respiration, it throws off the carbon which gave it this dark color, and becomes of a florid red: in short, it is converted from venous into arterial blood, or, as Professor Blumenbach would express it, from carbonized to oxygenated blood. Here then there is a similarity in the functions of these two important organs of the body, the liver and the lungs: each co-operates in the same design; in the one the blood is purified by the process of respiration, in the other it is purified by the process of secretion. The blood in the liver produces bile, which is thrown out into the alimentary canal; but such is the admirable provision of Nature, that the very same substance which would be prejudicial to health, if it were retained in the blood, is beneficial to the health when it is transferred to the bowels: here it exercises an important influence in the digestion, the assimilation, and animalization of the food; it corrects acidity, it promotes appetite, and acts as a gentle stimulus, keeping up what is called the peristaltic action of the intestines.

Here then are two ways by which the health of the body is maintained, by the secretion of the liver, and by the respiration in the lungs; but there is another process to which we must likewise direct our attention, and that is the secretion from the surface of the skin. Of the importance of this secretion we may form some estimate from the accredited statement of Sanctorius, that, of eight pounds that we eat and drink, five pounds go off by insensible perspiration. Now then, having these facts in our recollection, you will easily perceive how far they are applicable, in explaining the phenomena which accompany that disease called "common cholera."

During the hot months of summer, the blood is determined in great abundance to the surface of the body, the perspiration is increased through the pores of the skin, consequently a larger proportion of that carbon which would, under other circumstances, have contributed to the secretion of bile, is thrown off by the same outlet; the bile, therefore, is deficient in quantity, and perhaps at the same time different in quality, from what it would have been, if not deprived of this important principle. Whenever the secretion of bile is deficient, the digestive powers are impaired, the mucous membrane which lines the whole surface of the stomach and bowels becomes dry and irritable, till at last it gets into a state of what is called erythematous inflammation, and, when this is the case, the slightest accident, such as eating acid fruit, indigestible food, being chilled by exposure to the evening dews, or even the morning air, if the body should happen to be heated at the same time, the whole system, and especially the stomach and bowels, are thrown into convulsive agony, and such is the violence of the attack that death often terminates the scene in less than twenty-four hours.

Such is the picture, an imperfect one I admit, of what is called "common cholera;" and this I contend originates in a morbid irritability of the stomach and bowels, principally occasioned by the want of secretion of bile.

A very learned writer, with whom I had once the honor of being well acquainted, I mean Dr. John Mason Good, whose name must ever be associated with feelings of profound respect for his abilities, in his elaborate work on the study of medicine, speaks without hesitation of the common cause of "common cholera" as a superabundant, and, perhaps, acrid bile; but this assertion he makes, not as the result of his own personal examination, which would probably have led to a very different conclusion, but on the authority of Sydenham, to whose opinion on these points many persons are disposed to attach a degree of importance amounting almost to infallibility; but, willing as I am to concede to such authority all the credit to which it is reasonably entitled, I must still claim the privilege of thinking for myself, and the very weight of his authority on this occasion becomes a motive for opposing him, as it is calculated to give greater publicity to his opinions.

The term Cholera, then, is equally inapplicable to this as well as the Asiatic Cholera; but in this case the want of bile is the cause of the disease, in the other the want of bile is the effect of the disease. In the Asiatic, or what, perhaps, will be better designated the *Blue Cholera*, the first attack is on the living principle, and what that is I will hereafter endeavour to explain; in the common Cholera the first impression is on the bowels. In the Blue Cholera the affection of the bowels is occasional and incidental; in the common Cholera it is invariable and essential. In the blue Cholera the first object is to restore the energies of the system; in the common Cholera to promote the action of the Liver. We have it from the best authority that if, in common Cholera, the patient can be brought to throw off bile from the stomach, he is sure to get well. But be it remembered, and this is the very gist of the argument, this is the phantom of false philosophy, which has led, or rather misled, those who have given this name to the disease. It is not that bile which has occasioned the disease, but that which being brought on by the efforts of nature, or the operation of remedies, has cured the disease. The rejection of bile is a certain indication of a speedy recovery.

How far then are these opinions ratified by experience? What are the remedies which in conformity to this theory one would be disposed to recommend?—Why calomel and opium,—the opium to allay the irritability of the stomach, and calomel to promote the secretion of the bile; and these are the only remedies which are found competent to cope with the disorder. And, perhaps, there never was an instance in which theory more directly tended to point out the practice, or practice contributed to confirm the theory.

I cannot dismiss this part of the subject, without urging the necessity of distinguishing the want of bile in the stomach from the predominance of bile in the blood.

About twenty years ago I published a work *on Disorders of the Stomach, with remarks on the use of the bile in promoting digestion*, in which I pointed out the importance of this distinction; and since that time I have met with many persons who have become proselytes to my opinion. A person is said to be bilious—granted; but in what sense? not from having too much bile in the stomach, that I most strenuously deny, but from having that matter which ought to be converted into bile still floating in the blood, or retained in the Liver. So long as this matter is retained in the blood, it produces heaviness, stupor, languor, lassitude, and every symptom of debility; it brings on passive hæmorrhages, palsy, dropsy, apoplexy, and a variety of other diseases which it would be irrelevant to my present purpose to enumerate or describe.

Hence arises the necessity of attending to the state of this important secretion; hence the benefit which arises from the various articles in the Materia Medica that come under the denomination of aperients, cathartics, and eccoprotics; this is the principle of their operation, whatever may be the basis of their composition, to promote the secretion of bile, and carry off the carbon from the blood; and the man who ventures to prescribe without a governing principle to direct his views is like a person shooting in the dark—he may happen to wound his friend when he intended to kill his enemy.

Reverting then, Gentlemen, to the subject of Indian Cholera, which has swept off the millions of the multitude, and struck the nations of the earth with consternation and dismay, and which from its proximity to our own habitations is well calculated to excite our alarm, I shall endeavour to give you a very summary history of its symptoms, and offer a few remarks on the treatment; for you will please to remember it is not my intention to give an accurate and elaborate history of this disease, nor can I enforce the authority of my advice by a reference to my own personal experience.

I come here for the express purpose, and I should be sorry if my object were misunderstood, of communicating certain principles which I have never yet publicly divulged,—

principles which are not the crude conceptions of the present moment brought forward on the spur of the occasion, but which are the result of long and mature consideration,—principles which I have carefully examined and usefully applied,—principles which all that I have yet heard have tended only to corroborate,—principles which I think calculated to throw some light on this most formidable disease ; but principles, at the same time, which I am willing to abandon if they should be found incompatible with truth.

Instead, therefore, of attempting to give a history of the disease, which it would be impossible to do on this occasion, I shall select some of its most prominent symptoms, and such as will best serve to elucidate the principles to which I allude, taking care, as you may naturally suppose, to introduce nothing that can offend the most fastidious delicacy.

" A knowledge of diseases," said the late Dr. Beddoes, " should be introduced into the bosom of families," and the broad outlines of Medical Science ought, in my opinion, to form a part of general education, as the best antidote to empiricism.

I shall give what I have to say as a series of observations. It has been observed, then,

Firstly,—That the disease generally comes on in the night or towards morning, though to this there are many exceptions.

Secondly,—The attack of the disease is frequently instantaneous, attended with complete prostration of strength.

Thirdly,—The circulation of blood in the veins seems to be completely stopped, and is so feeble in the arteries that the pulse, which is extremely weak, becomes at last imperceptible, and instances have occurred where patients have been known to survive three days after all pulsation in the wrist had ceased.

Fourthly,—The skin, *which is cold* and covered with cold clammy sweats, in European constitutions assumes a blue color, the lips are blue, and the nails assume the same hue; and in this state the skin is insensible even to the action of chymical agents.

Fifthly,—*The breath is cold.*

Sixthly,—There is almost always an urgent thirst ; though the tongue is not in general parched, yet there is no secretion of saliva and the *tongue is cold.*

Seventhly,—The voice becomes feeble, hollow, and unnatural; the countenance undergoes a sudden and striking alteration; the eyes are sunk and apparently drawn into their sockets, and surrounded by a black circle ; the nose becomes sharp and pointed, and the whole presents a most cadaverous aspect.

Eighthly,—The blood when it can be drawn is always dark or almost black, very thick, and ropy, but the most extraordinary fact is, that—

Lastly,—With all these symptoms of extreme debility and disorganization, the mind remains clear and its functions undisturbed, almost to the last moment of existence.

From this description I can perfectly well conceive the appearance of the patient, and that it would be impossible after once seeing it to mistake the physiognomy of the disease. I have often seen something which approximates to the picture, in those distressing cases which it is our painful duty to witness, where poverty and sickness have combined together to form the aggregate of human misery.

Sickness and Poverty combined!

Can I make this remark without some commentary on the expression?

When I see Merit pining in obscurity, and Vice rioting in prodigality,—when I see the Worthless and the Indolent abounding in Riches, and the Worthy and the Industrious at a loss for a meal,—I confess I do feel a spirit of indignation stirring within me which it is difficult to suppress.

But surely the time is now come, or, if not, it never will arrive, when the miseries of the poor must call forth the sympathies of the wealthy. "Hunger," says a celebrated writer, "is not a postponeable evil," and when we see old age flocking to the Work-house, and inexperienced youth hurried to the gallows, we cannot but suspect that there is something rotten in the state; but let us hope that, seeing as we do how much the magnitude of the calamity which approaches us is aggravated by the poverty of those whom it attacks, that that relief will not be wanting which it is in the power of affluence to bestow, that Avarice itself will become liberal, and that they who are peculiarly favored by the blessings of Providence will also be particularly distinguished by the generosity with which they impart these blessings to others.

Gentlemen, I have studied the character of the human mind,—I have seen the effects of Adversity, and I have read the heart of man in the pages of prosperity, and I have come to this conclusion—that money is the curse of the world; it roots up every noble and generous sentiment that animates the heart of man, implanting in its stead a spirit of pride and selfishness; can any one see the misery which every where surrounds him, and not feel that his heart sickens at the sight? can any one be so blind as not to perceive that the political body is in a state of disease? this is the fact, and this is the feeling that must plead an excuse for the digression.

If any man suppose that I come here merely to afford him amusement for an hour, he has mistaken both my character and my intentions: I come here to communicate some ideas which

I think may be usefully applied; and, if in so doing I have been tempted to improve the opportunity by pleading the cause of suffering humanity, I hope I have not been speaking "in an unknown tongue."

With respect to the treatment of the disease, perhaps the less I say the better; fortunately in the present day no one need die for want of a Doctor; and if the Cholera should carry off three-fourths of the profession (the present company excepted) perhaps it would not be thought so great a calamity.

However, Gentlemen, to be somewhat more serious, the reason why I do not, and why I cannot, lay down any particular instructions on the treatment of the disease, is this—that the difference of climate and constitution may so modify its symptoms, that what may be proper in India might be found pernicious in England: for instance, it might be right to bleed freely in one case, and not in another; to give Calomel largely in one case, and not in another. Nevertheless, there are some points on which it may be right to impart some general information; but this I apprehend it will be better to omit till

I have had an opportunity of explaining the principles by which that treatment should be regulated. He that goes to the bed-side of a patient, with his mind previously prejudiced in favor of any particular plan of treatment, is so far disqualified to prescribe with advantage.

We must now come to another very important question with regard to the character of this disease, and that is—"Is it contagious?" I have ventured to say it is not, and I have already given some degree of publicity to this opinion by mentioning it in the Egyptian Hall, but was prevented from assigning my reasons for thinking so, and my reasons for saying so.

To me it appeared an object of the greatest importance, both as it regarded our domestic happiness as well as our commercial interests, not to propagate the erroneous notion of its being contagious,—a notion which, in my humble opinion, Government has adopted with too much precipitation by carrying the Quarantine Laws into effect. It may seem presumptuous in me to question the wisdom of the Legislature, but the impolicy of the act must be obvious to all: For what do we do? We announce to all the world that we are an Infected people, with whom it is dangerous to hold communication. With what avidity will they seize on the intelligence who are interested in excluding our manufactures? What Bonaparte, in the plenitude of his power, was unable to accomplish on the part of the French, we do for them in the plenitude of our apprehensions; even smuggling cannot avail us, for people will not be inclined to smuggle that which may endanger their existence. Already have they begun to lay restrictions on our commerce; and Spain and other countries have followed the example. Quarantine laws, if they are acted upon at all, should be rigid and imperative; they should be complete and comprehensive; so complete that not one scabby sheep could escape: now is this practicable? is this possible? I would ask. I leave the question to be answered by your better understandings.

Since I wrote these remarks I have read a letter so replete with good sense, sound argument, and conclusive reasoning on this question by Dr. George Lefevre, physician to the British Embassy at Petersburgh, that though many of you may have already read it in the public papers, I shall beg permission to read a part of it here; they who have not seen it will be glad to be informed, and they who have seen it will have no objection to be reminded, and he that can be an advocate for contagion after this must be beyond the reach of conviction.

"As to the question of contagion," says Dr. Lefevre, "I would ask once for all if a disease is not communicated by wearing the same clothes, sleeping in the same bed, and going into the same bath, from which patients severely attacked by it have been removed—if a constant attendance upon the sick—if all the offices performed by medical attendants and nurses are not found to communicate the contagion, is it possible, I ask, to call this disease contagious?

"In Petersburgh, out of 2000 English residents only fourteen died of this Epidemic, and how was this? not by shutting themselves up in their houses, or shunning the disease, for they were to be found at the bed-side of their domestics, administering the medicines with their own hands:" so much for *Anticontagionism*. Now what says this intelligent physician with regard to the operation of *Contagionism?* (if I may be allowed the expression) what have been the practical effects of inland Quarantine laws?

I shall give the quotation at full length, as I know I am fulfilling the wishes of the writer by giving publicity to his opinions, who, though living at a remote distance, has given us a proof that his Country's welfare is a Briton's pride—that England is his home—and that

> Where'er he roams, whatever realms to see,
> The heart untravelled fondly turns to thee.

"From all the evidences I can obtain upon the subject," says Dr. Lefevre, "I am perfectly convinced that when once the Cholera has invaded a Country, epidemically, there are no means of preventing its propagation. If we consult the public journals of Austria and Prussia, we shall find this truth so clearly illustrated, that it would be arguing against the light of reason to insist upon the necessity of Cordons after the disease has once fairly established itself. The following is an epitome of the reports of the Cholera's progress through these countries. 'We are sorry to inform our readers that the Cholera Morbus has made its appearance in a Frontier Town of the Empire; but as the Government has adopted the most vigorous measures, and has placed a Cordon round the Town itself, there is little apprehension of its extending itself further. All goods and merchandise coming from the said town must be well fumigated and purified; and any person breaking the Quarantine will be tried by military law.'

"Hardly had this notice been published when the next journal informs us that, in spite of all precautions, the disease has penetrated farther into the Empire, and that more severe measures are adopted to prevent its reaching the capital. A double Cordon is now established around each infected place; a few days more, however, and we hear that the malady, in spite of all that has been hitherto done, is plodding on slowly but surely; the severity of the measures seems to have had no other effect than that of ptoducing general discontent, and in many places rebellion among the people, who having suffered patiently for a long time are now compelled, from want of the necessaries of life, to break through the Cordons;—the soldiers fire upon them, and blood is shed without any adequate advantage. The progress of the malady now creates alarm in the Capital;—a Council is held;—the medical faculty decide "that the measures hitherto adopted are totally inefficacious, and the two sovereigns immediately order all those vexatious measures to be abolished, which have only tended to distress their subjects. The Cordons and Quarantines having been abolished, we do not find the disease making greater ravages; but, on the contrary, sensibly diminishing, because the minds of the people are not agitated by the fears which such measures necessarily create, nor are they exasperated by restrictions which interfere so much with their common habits. The establishment of Cordons, therefore, is not only unnecessary, but highly prejudicial to the interests of society; for we see that, when the strictest have become established, they have not arrested the progress of the disease, and that where no such measures have been adopted many places have escaped altogether. The very idea of fixing a signal of contamination on particular houses, Dr. Lefevre ridicules as preposterous and absurd:" "imagine," he says, "a black board, with the word *sick* inscribed upon it, affixed upon a house in London—why all the inhabitants in the street would be in a state of jeopardy, not a soul but would have a pain in his stomach till the board was removed." "Whether," he adds, "it be possible, that goods and merchandise, which have been exposed to an atmosphere impregnated with Cholera, may communicate it to those employed in unpacking them, is perhaps doubtful; but I cannot, without disbelieving the evidence of my senses, imagine that it is communicated from one being to another by mere bodily contact." Now, who is it that addresses us in such positive and impressive language? is it a rash, inconsiderate, inexperienced, theoretical young man? No, it is a man of mature age, and distinguished abilities, who has witnessed with his own eyes what he has written with his own hands; who tells us, with all the confidence of truth, and all the candor of philosophy, that this disease is not contagious.

One short extract more, and I have done,—"There is this peculiarity in the Cholera, it attacks the dissolute and the drunkard in a tenfold ratio, so much so that, when it passed the Persian frontier, it was observed to clear the towns it invaded of all such as by their drunkenness and debaucheries were a nuisance to society."

Who can tell then what advantages may ultimately arise from that which we now so painfully anticipate? That which is now the object of our fears, may hereafter be the subject of our gratitude; it may purify the moral atmosphere, renovate and exact the social feeling, engender and diffuse new sympathies in the soul, and strengthen the moral obligations that bind man to man. Let us then, in the indulgence of these pleasing hopes, be prepared to meet the disease with becoming resignation, fully assured that he who provideth for the Sparrow, and providently catereth for the Raven—who rides on the whirlwind and directs the storm, will temper the severity of the affliction, and visit us with healing on his wings.

Having, then, Ladies and Gentlemen, made these general remarks on the subject of Cholera, I now proceed to the development of the principles to which I have previously alluded; and, in order to render them at once familiar and intelligible, I must direct your attention to those operations which are the most conspicuous in the physical character of man. I must examine him as an unknown being, distinct from ourselves, just started into existence, and who has awakened our curiosity by the novelty of his appearance.

Let us suppose, then, that, like the peasant in Brobdignag, we had picked up this little Gulliver by accident in the field, and that the philosophers were assembled to examine his structure and peculiarities. The first most striking phenomenon would probably be the expansion of the lungs, the elevation and depression of the ribs; they would soon discover that this proceeded from the air passing from the mouth and nose, into and out of the lungs, and that if these passages were completely closed he would die in a few minutes; this is *Respiration.* If watched a little longer, they would perceive, supposing the "*materiel*" to be at hand, that he took food into his stomach, and that, if he were kept many days without it, he would not be able to survive; this relates to *Digestion.*

Another phenomenon, too, could not be overlooked; that, after a certain length of time, he would become fatigued, consciousness would forsake him, his mental faculties would become suspended, and he would fall asleep. It would be found that, as the body required refreshment, so the brain required repose. *But* that, during the whole period of mental inactivity, his lungs still continued to perform their functions with unremitting punctuality.

Now these are the three Great Organs that form the Pillars of the Constitution—(can any man, for a moment, doubt the validity of the assertion ?) and from them I have derived those principles which I am now about to explain, but I feel it necessary to be cautious in the communication. I do not wish to draw an inference before I have established my premises ; nor do I want to gain your consent before I have convinced your understanding.

Now, supposing these philosophers (it is paying them a great compliment I admit) to be as wise and inquisitive as yourselves, they would naturally ask, " What is the use of this process which you call Respiration ?" and the question would be much shorter than the reply ; as to answer it satisfactorily it would be necessary to enter a little into detail, and to begin by stating that, about the year 1628, a certain individual, called Dr. Harvey, found out, by a series of well-conducted experiments, what is called the *Circulation of the Blood;* and though he was strenuously opposed by the malevolent ignorance of his contemporaries, and materially injured in his professional pursuits, the soundness of his doctrines soon silenced the clamor of his opponents, and Truth triumphed, as it always will, when Ignorance does not oppose impediments to enquiry. The gratitude of posterity, fully appreciating the merit of the discovery, has endeavoured to atone for the neglect of their predecessors, and the name of Harvey is written in imperishable characters on the Records of Fame.

Far be it from me to say any thing that might tend to tarnish the brilliancy of his reputation, or pluck the laurel from his brow; but this I will venture to affirm, that the discovery of the circulation, great as it was, is scarcely equivalent to the more recent discoveries of modern philosophers—with respect to the change which the blood undergoes in its passage through the Lungs. With regard to the former, the wonder is that it was not discovered before; with respect to the latter, that it was discovered at all. The former seems to have been the natural result of Anatomical examination; the latter required the most ingenious and careful chemical analysis, and is a glorious evidence of the importance of chemical science, and the abilities of those who were engaged in the pursuit. But without attempting to form a comparative estimate of the value of these two discoveries, it will be sufficient for me to avail myself of their advantages, and to make them subservient to my purpose in the illustration of my principles.

I must recollect that I am now answering some imaginary personage who is perfectly ignorant of the Animal Economy, difficult as it may be before such an audience to maintain the delusion. Admitting, then, the circulation of the blood as fully accredited, and partly understood, of what use is Respiration? Why must the air pass into and out of the Lungs? You must excuse the apparent simplicity of the enquiry. Recollect, Gentlemen, I have to establish first principles, and, in the most complex arithmetical calculation, it may be necessary to begin with stating that two and two make four. Respiration *is* essential to the circulation, it is essential to the support of life, and so essential that not only men and animals, not only birds and beasts, not only insects and fishes, but even vegetables themselves are compelled to respire in order to maintain their existence; they must not only take in air, but they must take in air possessing properties peculiarly adapted to their constitution.

Now as we must necessarily breathe the air with which we are surrounded, as we must in every act of inspiration inhale atmospheric air, the next question, and it may fairly be said to be a question of vital importance, is, What is atmospheric air? Is it a pure, simple, undecomposeable elastic gas? or is it compounded of different gases, which it is possible to separate and re-combine? This is the question which has for ages puzzled the philosophers of ancient times, but it is now satisfactorily answered by the discoveries of modern science.

Every body knew that air became contaminated by repeated respiration; common observation was sufficient to confirm the fact: but to what this was attributable was a mystery beyond the ken of their capacities. I will answer the question presently; but it would be an act of unpardonable injustice if, in the solution of this question, I should neglect to mention the names of those to whom we are indebted for the information we have acquired. Harvey claimed the doctrine of the Circulation of the Blood as exclusively his own, though the germ of the discovery may be found in the writings of Servetus; but the doctrine of Respiration has been established by the combined operations of many.

In the early periods of uncultivated science, Fire, Water, Earth, and Air, were considered to be the four great Elements of Nature; this was the opinion of Aristotle, and the weight of his authority combined with the prejudices of the times to forbid a doubt of his opinions.

Many revolving centuries passed away in listless ignorance and contented stupidity, with regard to this branch of philosophy, till the great Bacon burst out like a meteor in a midnight sky, to dissipate the surrounding darkness, and illuminate the path that led to the Temple of Knowledge. His mighty mind, rejecting the unsatisfactory fancies engendered by Ignorance in the lap of Superstition, and spurning the authority of ancient prejudices which had too long usurped dominion over the human mind, sought for Truth, not in the musty records of remote antiquity, but in the more instructive pages of the great volume of Nature. Succeeding philosophers followed in the same track, and Newton, Boyle, Paschal, Galileo, and others, have stamped immortality on their names by following the course of his example.

Mayow was the first person that appears to have entertained any rational opinion with regard to the composition of the atmosphere, though many hints had been thrown out previous to his time, which seemed to approximate to the same ideas. Hippocrates reckoned air a species of aliment; Pliny calls the air a vital spirit; and even Cicero affirms that the heart imbibes a spirit from the air; and Borelli goes so far as to say that the use of respiration consists in the admission and admixture of air with the blood, in order to inform those elastic globules of which it is composed, to give it its florid redness, and to prepare it for many purposes of the animal economy: but all these were conjectural opinions, unsupported by experimental proof, and incapable of practical demonstration.

Mayow lived about 140 years ago; he was contemporary with Boyle, Lower, and Wilson; and so acute was his observation of natural phenomena, and so accurate his judgment on the causes which produced them, that, according to Dr. Beddoes, to whom he is indebted for the preservation of his fame, he may be said to have anticipated the discoveries of the present day; and, had he but known the properties of oxygen in its pure and isolated state, he would probably have established the principles of respiration, combustion, and the formation of acids, of which he seems to have had a sort of intuitive perception.

This great and important secret in the operations of pneumatic chemistry it was the peculiar privilege of Dr. Priestley to unravel ; and, in the year 1774, he enlightened the scientific world by the brilliancy of the discovery ; the celebrated Swedish chemist, Scheele, who was at that time occupied in similar researches, ascertained the same fact. And Lavoisier, the great French philosopher, whose untimely death was a disgrace to his ungrateful country, by experiments which were at once ingenious and conclusive, fully confirmed the truth of the discovery. Priestley called it dephlogisticated air; Scheele distinguished it by the more classical and romantic appellation, empyreal air ; but Lavoisier called it oxygen, and stamped perpetuity on the name.

Lavoisier ascertained not only the nature of the gases of which the atmosphere is composed, but the proportions in which they are combined ; and the result of his analysis I shall now give, as an answer to the question, What is atmospheric air? It is an air composed of two other airs, of oxygen and azote, in the proportion of 27 parts of oxygen and 73 parts of azote.

Before I enter into the examination of the specific qualities peculiar to each of these gases,—and before I undertake to answer the question, proposed some time since, as to the use of respiration, in keeping up the circulation of the blood,—I must direct your attention for a few moments to one point, which it is of importance to attend to in the examination of aërial bodies; I mean the caloric, or matter of heat, with which they are combined; and, perhaps, I shall render my meaning more intelligible by choosing water as the subject of illustration.

When water is placed in a situation where the temperature is below 32 degrees of Fahrenheit's Thermometer, we know it undergoes a very remarkable change,—it is changed from a fluid into a solid body, and it becomes ice. This is owing to the water having parted with that portion of the matter of heat which it previously contained and by which it maintained its fluidity; it has therefore been called the *caloric of fluidity*. If, instead of being placed in this cold situation, it had been put into a vessel capable of sustaining the action of heat, and placed upon a brisk fire, instead of becoming ice, it would after a certain time have been converted into steam, and, by continuing the operation, the whole of the water would be made to disappear. Simple as this process appears to be, because it is familiar to our senses, nothing in the whole history of magical incantation can be so wonderful;—that a substance, firm and incompressible as the adamantine spar, should, by the addition of a few degrees of heat, be first reduced to water and afterwards converted into steam, is a phenomenon which by a mere effort of the imagination it would have been impossible to conceive; whatever may be the intensity of heat to which this water is applied, its temperature under the common pressure of the atmosphere never rises above 212 degrees: beyond that it has not the capacity of containing heat, and therefore it is converted into steam. You see then, Gentlemen, that this steam, dissipated in the air and reduced to its primitive principles, which are oxygen and hydrogen, carries with it a very large proportion of the matter of heat.

Oxygen gas is therefore the base of oxygen combined with the matter of heat; when therefore, from any circumstances, this oxygen is changed from the state of gas in which it is so often found—when it becomes solidified by entering into combination with other bodies—it gives out that quantity of caloric which was necessary for its preservation in an aërial form; and now we begin to perceive some glimmering light that may lead to the solution of this important question, What is the use of respiration in. carrying on the circulation of the blood?

Here then, Gentlemen, for the present, I think it will be adviseable to conclude, as I find it will be impossible to bring all I have to say within the compass of one Lecture. I must therefore claim permission to supply the defect on another early opportunity, when I hope to be honored by your attendance, as I should be very sorry to give an imperfect explanation of principles which I am anxious should be perfectly understood. I believe the influence and importance of carbon in the operations of the animal economy to be at present as little understood as the properties of steam were in the seventeenth century, and that it affords a wide, uncultivated, and profitable field for the labors of future physiologists. I merely presume to hope that, in the few observations I may hereafter make, I may have the merit of exciting their enquiries, and that I may be like the

> ——————————" *Hone,*
> Which gives edge to razors, though itself has none."

I ought perhaps, Gentlemen, to apologize for venturing to offer my opinions so freely as I have done on a subject on which I have had no personal experience; I have therefore been obliged to draw my conclusions from the experience of others: this circumstance may tend to invalidate the weight of my authority, unless you can suppose that he who is at an elevated distance from the battle can best observe the movements in the field.

To form an accurate diagnosis of the disease, to measure the degree of its malignity, and prognosticate the result, are points on which I would not presume to come in competition with those who have had better means of information; but perhaps I may be permitted to sit in judgment on the conflicting testimonies of those who have watched the progress of the disorder, and to try if possible to explain the discrepancies of opinion which are found in their publications. Besides the duty is imperative;

for we may be soon called upon to apply principles to practice, and to act for ourselves.

And, should the occasion occur, is there any one who will shrink from the performance of his duty? *No!* There is a spirit of philanthropy in the bosom of an Englishman that makes him reckless of danger, and indifferent to fate, when the calamities of his country require his aid. If we abandon those whom it is our duty to relieve, we forfeit our own claims to commiseration; but, if we die in the discharge of our duty, then have we the surest foundation for future hope, and, when Death does summon us away, then "will that very voice which thunders terror to the guilty heart, with tongues of seraphs whisper peace to ours."

LECTURE II.

Ladies and Gentlemen,

In the concluding part of my last Lecture, to which it is necessary to refer, in order to form a proper concatenation with that part of the subject and that which I am now about to enter upon, it will probably be recollected that I left off with mentioning the two great discoveries, which have contributed so much to enlarge our views, and to assist our researches in the science of Physiology; these are, Respiration and the Circulation of the Blood.

They are discoveries of such deep and transcendant interest, so intimately connected with our general health and our temporal happiness, that no one can be indifferent to the subject. In examining the physical character of man, I mentioned the three most important phenomena, Respiration, Digestion, and Repose, or Sleep. That the Brain, the Stomach, and the Lungs, were the three great Pillars of the Constitution; and now I shall endeavour to show that carbon, oxygen, and vitality, are the three great elements of which the constitution is composed; and that when these elements are properly apportioned, and suitably combined, the physical character of man is complete.

Shakspeare seems to have had a sort of intuitive perception of the truth of the philosophy, when he said, speaking of Brutus,

> The elements
> (Were) so mixed in him that Nature might stand up,
> And say to all the world, this was a man.

In the development of these principles I feel that I shall stand much in need of your indulgence; a dry detail of facts, though it may satisfy the understanding, can afford no feast to the imagination; and I shall not attempt to embellish what I endeavour to explain, believing, as I do, that perfect truth, like perfect beauty, needs not the foreign aid of ornament, but is, when "unadorned, adorned the most."

Speaking with reference to the function of respiration, I stated that the dark color of venous blood conveyed to the Lungs was attributable to a quantity of carbon, with which that blood was combined; and that the atmosphere we breathe was composed of oxygen and azote, or what is now more frequently called nitrogen gas: and, though there are some circumstances connected with the process of Respiration which are still the subjects of controversy, the two points to which I now allude are, I believe, generally admitted to be true. I will merely add, for the sake of accuracy, and that I might not be supposed to be ignorant of the fact, that there is a very small proportion of carbonic acid gas combined with atmospheric air; but so small, being about one part in a hundred, as not to have any important influence, none, at least, on any explanation which I am about to offer: small as the quantity of carbonic acid gas is found to be, it is not accidental or occasional, but is always present in this limited proportion, and may, therefore, possibly possess more importance than I am at present disposed to ascribe to it.

With regard to the proportions of oxygen and azote in atmospheric air, philosophers have not given precisely the same estimates. The accurate experiments of Berthollet, De Marti, and

Sir Humphrey Davy, agree in fixing the proportions at 22 of oxygen and 78 of azote; whilst Fourcroy, in his elaborate work on Chemistry, sets down 27 parts of oxygen in the hundred. The best way, perhaps, to account for the different results of these eminent chemists, without impeaching the accuracy of either, is to infer, that one speaks with reference to the volume of these two gases, and the other with reference to their proportional weights, which will be found to make the result similar.

In the act of inspiration, then, a certain quantity of atmospheric air enters the Lungs, where it meets with the venous blood, which is loaded with carbon. The carbon having a powerful affinity for oxygen, they immediately combine together, forming carbonic acid gas, which is thrown off in the act of expiration; whilst the caloric which the oxygen contained, being disengaged, enters into combination with the blood, raising its temperature, and contributing very essentially to the formation of arterial blood; the carbon of the blood, however, can only take up as much oxygen as it is able to contain, or as is sufficient to convert it into carbonic acid gas. Another portion of the oxygen enters into combination with the blood, and this is supposed to be the revivifying principle of arteria blood, that which not only gives it the florid color, but likewise the power of stimulating the Heart and arteries to contract. This doctrine was for a long time deemed quite orthodox, till some very plausible experiments made by Mr. Ellis, and afterwards by Messrs. Allen and Pepy's, seemed to shake the stability of the hypothesis. A more recent and profound physiologist, Dr. Edwards, of Paris, has subsequently silenced their objections, and given us reason to rely on the credibility of the fact, that the change from venous to arterial blood does not depend merely on the extrication of carbon, or the absorption of heat, but that a quantity of oxygen does actually enter into combination with the blood ; and this opinion I feel myself compelled to adopt.

I must beg leave to make one remark here with respect to the relative proportions of oxygen and azote in atmospheric air : they have been found to be the same in every part of the world, as far as chemical analysis has been able to discover; and, hence, many persons are disposed to deny that any benefit can arise in changing the air from an additional supply of oxygen, as the proportion is every where found to be the same ; but what does this prove ? it only proves that these two airs are chemically combined in definite proportions, according to the laws of chemical affinity, as they are found to operate in the combination of other bodies.

The protoxide of mercury is mercury combined with one portion of oxygen; the deutoxide is a second ; the peroxide is another ; all these have their assigned quantities of oxygen, and disclaim any further alliance with more ; so atmospheric air is azotic gas combined with a given and determinate quantity of oxygen ; but does it follow that there may not be, and that there is not, a large quantity of oxygen gas uncombined with azote, that may affect the salubrity of different situations ? and, independently of that, a great deal of difference must depend upon the temperature of the weather, for no one can for a moment doubt that the condensed atmosphere, in the frigid regions of the north, must contain a much greater quantity of oxygen, in a given bulk, than the more rarefied atmosphere of the torrid zone.

Leaving these speculations, however, alone for the present, let us keep to the doctrine of respiration, which will be found to bear a close resemblance to combustion, so much so that we may venture to assume, as an axiom, *that Life is a process of combustion,* that every phenomenon of the one will be found applicable to the other; and it is very curious that the language of poetry seems to have anticipated the inquiries of philosophy: we speak of the Ardent Mind—The Lamp of Life—The Fire of the Eye, &c., in all which the philosophy of combustion appears to be embodied; and even the word inspiration itself seems to have some allusion to the same theory.

We find the same air necessary to the support of combustion as to respiration: oxygen enters into combination with the burning body, a quantity of smoke is evolved, and a quantity of heat and light is disengaged. If we burn a candle in a given quantity of atmospheric air, as soon as the oxygen of that air is consumed, the remainder is no longer capable of supporting the combustion; neither is it fit for the purpose of respiration. If we pour a quantity of carbonic acid gas on the flame of a candle, the flame is immediately extinguished; and, if we draw in the same air through the nostrils, the lamp of life is extinguished with equal celerity.

This fact,—I will not shake its authenticity by calling it a theory, for it is a fact, and an established fact, that *Life is a process of combustion,*—is one of the most brilliant discoveries in modern science, and entitled to much more consideration than I can possibly bestow. I can only make one remark at present to exemplify its importance.

In the practice of a physician there is this mortifying reflection—that, probably, one half of the cases which he is called upon to relieve are beyond the reach of his remedies; and what aggravates the reflection is, that the greater proportion of the other half have probably been rendered incurable by neglect.

That prevention is better than cure is a familiar and proverbial expression; of how much importance is it then to prevent those diseases which, when once established, are found to bid defiance to all curable attempts! "Veniente occurrite morbo" is a sound and salutary maxim, meet the approaching disease, and is applicable to all, but more especially to some, such as fever, palsy, apoplexy, and consumption.

Life is a process of combustion; therefore, the moment the combustion begins to expire, we should trim the lamp and renew the fire.

The first indication of disease, particularly in all febrile and inflammatory affections, is a sense of cold and chilliness; and, when this is the case, we should never disregard the impression: it is the signal of an approaching storm; it is the instinctive monitor of nature; it may, in general, be easily subdued if speedily attended to; if it be not, then the necessity of further attention becomes more imperative, for if you cannot overcome the enemy you must submit to his authority, and take the consequences either of your negligence or inability.

If the feet feel cold and there be a sense of cold and chilliness, put the feet into warm water, take a little warm stimulus, such as brandy or ammonia, go into a warm bed, or between blankets; if this be sufficient to create a reaction, and to generate a genial warmth throughout the system, then no further danger is to be apprehended from that attack; but, if this should not succeed, we must resort to more powerful auxiliaries, bleeding, emetics, antimony, and the warm bath, must, collectively or consecutively, be put in requisition; for the danger of the disease will be proportionate to the difficulty with which it is subdued; and the remedies we employ must be regulated by a reference to this principle, that *Life is a process of combustion.*

In consumptive diseases this sense of chilliness is one of the most unfavorable symptoms: respiration does not produce its salutary effects, it does not oxygenate the system, or throw off the carbon from the blood.

It may be worth while to reflect for a moment on the powerful influence which this substance, called carbon, has upon the vital principle, as it may tend in some measure to account for the rapid and malignant operation of that destructive agent, be that what it may, which produces Asiatic Cholera.

A man in good health immersed in a vat of fermenting liquor, where carbonic acid gas is drawn into his nostrils, instantly drops down dead, or, at least, falls into a state called Asphyxia, or apparent death—for he may sometimes be restored. Now, why does he die, and how does he die? not from inflammation, certainly; it is impossible that inflammation can take place in a minute, and it is scarcely possible to conceive that he can die from any rupture of vessels, or disorganization of parts: he dies then from the extinction of the lamp of life. The very same gas taken into the stomach is palatable and refreshing, which, applied to the brain, produces instant death.

To render this still more intelligible, I shall borrow an illustration from the construction of the steam engine, of which the mechanism may be complete, but if the steam, which may be called the vitality of the engine, be withdrawn, all its vital operations are suspended: *The steam* is the *Life*, but the movements of the machine are the *functions* of Life. The boiler may burst, so may a blood vessel, but the suspension of the moving power, in either case, would produce death, though the mechanism be complete.

If I did not feel myself under a sort of injunction to confine my opinions on this subject to the explanation of Asiatic Cholera, I should endeavour to show the great importance of these facts in explaining the nature and character of fever, which some suppose arises from inflammation of the brain, though every phenomenon of the disease militates against the probability of the hypothesis. I presume to think I could furnish the most convincing proofs that fever, so far from being the effect of inflammation of the brain, is to be ascribed to a cause diametrically opposite to inflammation,—but this is a subject which it is not to my present purpose to pursue.

There are two things necessary to the advancement of Physiological Science—the one is a knowledge of facts, and the other is the application of that knowledge to principles. The truth of this observation may be fully illustrated by those grand and important discoveries which have contributed so much to improve the condition of man, and to give him the influence which he now maintains in the world that he inhabits.

When we look to those great discoveries from which the world has derived such important advantages, and compare the minuteness of the means with the magnitude of the results, we are overwhelmed with a sense of their disproportion, and are frequently no less astonished at the simplicity of the principle than the magnificent operations to which that principle may be applied; and perhaps you will allow me to mention a few by way of illustration:—may I notice, in the first place, the properties of the Magnet and its peculiar polarity.

This simple but singular property of its always pointing to the north, though viewed by the vulgar with idle and vacant curiosity, became in the hands of the philosopher the wand of an enchanter: it opened a path to the adventurous navigator on the trackless bosom of the deep, carried him from continent to continent, and from shore to shore, and made

> Columbus nobly dare to brave
> The untried terrors of the western wave.

Let us look to the electric property of amber, which has given a name to that powerful agent called electricity, and let us compare, though it scarcely admits of comparison, the knowledge we now have of that comprehensive science with the insignificant circumstance that first gave birth to the discovery.

Could any foresight or sagacity have been able to foretel to what useful, and at the same time destructive, purposes, a little black powder, accidentally discovered by a German monk, would in future ages be applied? that it would have changed the fate of war, and regulated the destinies of kingdoms? and that, whilst it gave greater facility to the destruction of human life, it would at the same time contribute to subdue the revengeful passions of War, by taking from the personality of the contest?

Could any one have anticipated the transcendant advantages which have arisen from that glorious effort of human ingenuity, the art of printing? which seems almost to have annihilated the distances of time and space, enabling us to stamp durability on the fleeting productions of the mind, to render our sensations at once tangible and transferrible,—

> " To speed the soft intercourse from soul to soul,
> And waft a sigh from Indus to the pole."

Lastly,—for this, from the novelty of the discovery, is calculated more especially to excite our astonishment,—the unmeasured and immeasurable properties of *steam*. "The master of mechanics, " says Dr. Johnson, " laughs at strength," and the powers of steam have confirmed the truth of the observation. This magnificent discovery, of which it is impossible at present to limit the extent, renders man in a great measure superior to the power of the elements: it laughs at the resistance of winds and tides, gives wings to commerce, certainty to speed, and punctuality to engagements, and yet all these mighty results are attributable to one single principle, the expansive power of steam.

I might mention others: but these four, the discovery of the loadstone—the invention of letters—the composition of gunpowder—and the powers of steam, are the four grand agents that have determined the fate of nations, and altered the condition of the world.

And why were they not discovered long before? Because the human mind was not brought to perceive the importance of attending to the principle from which they arose. Let us then, at any rate, endeavour to profit by their negligence, and not omit to make a suitable application of those principles which it is our privilege to possess.

There is at present a substance, familiarly known to every philosopher of the present day, called Carbon; it is known to possess properties peculiar to itself; to be undecomposable and indestructible; to be applicable to various manufacturing purposes; and, though it is known to have a powerful influence in the operations of the animal machine, it has never yet received a share of attention equal to its importance.

I have said that the black color of venous blood was owing to the quantity of carbon with which it was combined; and though the general principles of chemistry are at present so well known that, perhaps, it will not be necessary to make any commentary on the word, yet, for fear of being misunderstood, and as there may be some persons present who may be at a loss to conceive how carbon, or charcoal, can enter the blood, it may not be amiss to offer a few remarks on this wonderful production of nature—wonderful in its effects, and wonderful in its modifications. It derives its name from the Latin word Carbo, or Coal, and is the chemical name for charcoal, which is the black residue of vegetables that have suffered a complete decomposition of their volatile parts by fire.

Here too, as with regard to Cholera, we are liable to be misled by the meaning of the word; for, though carbon does form the basis of charcoal, it is by no means the substance to which it is exclusively confined; it pervades a great portion of our terrestrial globe; it enters into combination with bodies totally dissimilar both in quality and structure; it has a most powerful and paramount affinity for oxygen, and hence becomes a very valuable auxiliary in the manipulations of practical chemistry; combined with oxygen, it contributes to the formation of a numerous and important family called Carbonats; as the Carbonat of Soda, Carbonat of Potash, Carbonat of Lime, &c.; it is found in a gaseous, fluid, and solid form; it is the exhilarating and refreshing principle in those salutary beverages with which we are accustomed to slake our thirst in sultry weather, whose effervescent qualities are owing to the carbonic acid gas with which they are impregnated; even the very candles which we now consume are principally composed of carbon and hydrogen, which, by the process of combustion, are converted into aerial bodies; of this I can imme diately give you a palpable proof as well as ocular demonstration.*

Here is the carbon of which the candle is composed; the hydrogen, being more volatile, has made its escape, and here is the carbon converted into that substance commonly called lamp black, though this, when prepared in a large way, is made from rosin ; how different in appearance from the substance from which it was derived ! yet this was not generated by heat : it was only separated by heat, for carbon is a substance which no human power has yet been able to decompose.

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* This was done by merely holding a card in the flame of a candle till it was blackened by the smoke.

Now if you can only imagine that the digestive powers, or the animal functions, are capable of producing a decomposition of this substance, similar to what I have now done by the action of heat, you will easily conceive how a quantity of carbon should enter the blood, and how it should be thrown off from the surface of the lungs in the act of respiration, as is here done by the process of combustion ; for, though candles have not a place in the catalogue of modern luxuries, we eat various articles whose chemical properties are the same ; we eat fat as well as flesh, but, though we should discard both, we still take in a large quantity of carbon with our vegetable food, for carbon is the primitive and principal substance of which vegetable matter is composed.

I have asserted that carbon has a very powerful affinity for oxygen, a fact so well authenticated, as not to admit of any reasonable doubt.

But now I must beg leave to introduce to your notice another property which Carbon possesses, which is of as much importance in the functions of the animal economy, as its affinity for oxygen in the manipulations of practical chemistry; and that is its affinity for the matter of life.

The Matter of Life? to this brief but significant expression, I must beg leave to call your particular attention, as it forms the very foundation of my future reasoning.

To those who have always been accustomed to entertain the idea that life consists in a series of actions, there may be some little difficulty at first in comprehending the truth of the expression; it is impossible at once to renounce established opinions.

Opinions which have been implanted in early life, and riveted by repeated meditation, are like the figures painted upon China, which, being afterwards glazed over, and burnt in, it is almost impossible to obliterate ; a man whose mind is encrusted with prejudice, may be prevailed upon to give his assent to what he cannot confute, though, in the bottom of his thinking faculty, as Dr. Beddoes expresses it, he is still convinced it is a delusion.

What an admirable lesson of liberality is embodied in this principle ! it is, says a modern writer of great abilities, a most inconceivable paradox, that a man of liberal mind should quarrel with another on account of his opinions, since our opinions are of all things those which we can least call our own ; and, perhaps, the most liberal and enlightened minds are not aware how much their mode of thinking is biassed by primitive impressions.

To distinguish the Matter of Life from the Functions of Life is a sort of philosophical innovation, of which you may not at once be prepared to feel the force or to perceive the utility ; but, should any one have sufficient curiosity to pursue the inquiry, he will soon see the difficulties in which they have become entangled, and the inconsistencies into which they have been betrayed, who have refused to acknowledge the distinction ; they are like those persons who profess to disbelieve in apparitions, they deny it with their tongues, but confess it by their fears."

This is the case with Dumas, Richat, Richerand, Majendie, and most of the French physiologists ; they deny the existence of such a principle as a substantive essence, "as if," says Dr. Good, "nothing in natural science can be a fair doctrine of belief, unless its subject be matter of clear development and explanation." "This uncalled-for scepticism," says the same learned author, "has involved these philosophers in a dilemma, from which it seems impossible for them to extricate themselves, in admitting the existence of powers and faculties, without an entity or substantial base to which they belong, and from which they originate."

They allow themselves to employ the term, and cannot indeed do without it ; but, after all, they mean nothing by it. A quotation from Richerand will afford a striking proof of the justness of this observation.

"No one in the present day," he says, "contests the existence of a principle of Life, which subjects the beings who enjoy it to an order of laws different from those which are obeyed by inanimate beings, by means of which, among its principal characteristics, the bodies which *it animates* are withdrawn from the absolute government of chemical affinities, and are capable of maintaining their temperature at a near degree of equality, whatever be that of the surrounding atmosphere. *Its essence* is not designed to preserve the aggregation of constituent molecules, but to collect other molecules, which, by assimilating themselves to the organs *it vivifies*, may replace those which daily losses carry off, and which are employed in repairing and augmenting them."

Now, what is the sequence to this full and frank acknowledgment of a Vital Principle? Why it turns out, after all, that the whole of these expressions are Metaphysical; that *this essence*, which *vivifies* and *animates*, has neither being nor essence, neither vivification nor animation, nor reality of any kind; that the word Vital Principle is not designed to express a distinct being, but is merely an abridged formula denoting the totality of powers alone which animate living bodies, and distinguish them from inert matter, the totality of properties and laws which govern the animal economy!

So that we have here, not only the employment of terms that have no meaning, but properties and laws, powers and principles, without any source, a superstructure without a foundation, effects without a cause!

Can any one read this passage without perceiving the perplexity in which the author is involved, by rejecting the simple and intelligible meaning of the expression? Is it not sufficient to show, to prove, to establish the necessity of admitting that there is, not figuratively or metaphysically, but virtually, essentially, and substantially, what may be called The Matter of Life: but the term is not of modern invention.

The *Materia Vitæ Diffusa* is an expression recognized and adopted by those who have endeavoured to account for the phenomena of the Living World. And why did they adopt it? Because, in examining the variations and transitions of animated matter, they were compelled to resort to the expression.

This expression, then, for the same reason, I will adopt. This I will endeavour to explain; and this I will endeavour to apply.

The Earth is the great Parent from which we all directly or indirectly derive our subsistence ; and the fertility of the soil, where we are not indebted for foreign supplies, must, cæteris paribus, always be commensurate with the amount of the population. I omit to speak of the production of the waters, as that will be found, by parity of reasoning, to come under the operation of the same Laws.

Vegetables derive their nourishment from the soil, and graminivorous animals derive their nourishment from them ; whilst Man, the Lord of the Creation, renders both tributary to himself. Now, vegetables are substances which grow by the operation of their own intrinsic organization ; and whatever has the power to do this must possess life, for these are the Functions of Life. In common parlance, we say, such a tree is dead, or such a flower is dead, and they who may quarrel with the theory will find it very difficult to get rid of the expression.

In the Mineral Kingdom, we see changes brought about by the laws of Chemical Affinity. Hence, with regard to the animal, vegetable, and mineral kingdom, Linnæus was led to give this ingenious definition: Lapides crescunt, Stones increase; Vegetabilia crescunt, et vivunt, Vegetables increase, and live; Animalia crescunt, et vivunt, et sentiunt, Animals increase, live, and have sensation.

Now, as vegetables derive their vitality from the Earth, and as the earth cannot impart what it does not possess, it must follow that the earth possesses an animating principle, which vegetables have the power to extract.

This tangible, transferrible, invisible, and immortal principle, that gives beauty to the budding rose and vigor to the majestic cedar, that gives activity to the lamb and ferocity to the lion, that gives sensibility to the mind and irritability to the muscle,—this I call the Matter of Life, and to this I ascribe, and by this I explain, all the diversified functions of Animal and Vegetable life.

Now, then, admitting the legitimacy of the expression, let us endeavour to make it applicable as well as intelligible.

I have already stated that vegetables have the power of extracting the nutritious principle from the soil, and that animals living upon vegetable matter, have the power of decomposing the elements of which vegetables are formed, and of detaching the vital principle which they contain, and embodying it in themselves. By what means vegetables are enabled to perform this important process, we are unable to describe, excepting by means of the ramifications of their radical branches; but whether this be by chemical, capillary, or elective, attraction, is a point which I will not attempt to explain.

Sir H. Davy, whose celebrity as a chemist no one can for a moment presume to deny, in his Lectures on the Connexion between Agriculture and chemistry, ridicules the idea of a vital principle in plants; but we must recollect that, though he was a practical chymist, he was only a theoretical farmer. "Vegetables," he asserts, "may be truly said to be living systems, in this sense, that they possess the means of converting the elements of common matter in organized structures, both by assimilation and reproduction; but we must not suffer ourselves to be deluded, by the very extensive application of the word *life*, to conceive in the life of plants any power similar to that producing the life of animals.

"In calling forth the vegetable functions, common physical agents alone seem to operate, but in the animal system, these agents are made subservient to a superior principle. To give the argument in plainer language," says Sir Humphrey, "there are few philosophers who would be inclined to assert the existence of any thing above common matter, any thing immaterial in the vegetable economy: such a doctrine is worthy only of a poetic form—the imagination may easily give Dryads to our trees, and Sylphs to our flowers; but neither Dryads nor Sylphs can be admitted into vegetable physiology; and, for reasons nearly as strong, irritability and animation ought to be excluded." This is Sir H. Davy's method of reasoning with regard to vegetable life."

Now, by way of Antithesis, let us hear what Dr. Darwin says: he says, "there is a kind of taste or appetency at the extremities of the roots of vegetables, similar to that of the extremities of our Lacteal vessels, for the purpose of secreting their proper food; and besides different kinds of irritability or appetency residing in the various glands which separate honey, wax, rosin, and other juices from their blood, vegetable life seems to possess an organ of sense, to distinguish the variations of heat; another to distinguish the varying degrees of moisture; another of light; another of touch; and, probably, another analogous to our sense of smell. To these must be added the indubitable evidence of *their passion of love*, and of their necessity to sleep; and I think we may truly conclude, that they are furnished with a brain, or common sensorium belonging to each bud."

Dr. Darwin, in his Loves of the Plants, has suffered his poetic imagination to go beyond the boundaries of philosophical discretion; he even goes so far as to accuse certain female plants of occasional acts of infidelity; but here I must leave him, not feeling myself competent to interfere in such delicate investigations.

In the Animal Kingdom there is a receptacle called the Stomach, connected with an apparatus fitted for digestion, by which this object is accomplished: I mean the extraction of the vital principle. In the human body we find several organs which are, more or less, essential to the digestive function, such as the liver, the spleen, the pancreas, and the salivary glands; but in all animals, in whom some of these organs are wanting, a stomach is always to be found, and is so universal as to form a line of demarcation between the animal and vegetable world.

What then is digestion?

I define it to be *that process by which the vitality of the food is separated from the substance by which it is combined.*

In establishing this proposition, I do not feel it at all incumbent on me to enquire into the particular mode by which digestion is accomplished, whether by solution, fermentation, or trituration; whether by the muscular action of the stomach in man, or the gizzard in fowls; whether by the solvent power of the gastric fluid, or the chemical affinities of matter.

Whatever be the process this is the result, the abstraction of the living principle from the body with which it was combined; if the stomach have not the power of extracting this principle from the food which is taken in, that food, whatever may be its absolute nutritious quality, is, relatively to that stomach, either useless or pernicious; hence the philosophy of the expression, which is at once familiar and true, that "*what is one man's meat is another man's poison.*" We know there are various plants which, though poisonous to some animals, are eaten by others with impunity and advantage. There are numerous tribes of insects that feed and fatten on all the species of Euphorbia or noxious spurge; the Indian Buceros feeds to excess on the nux vomica; the land crab on the berries of the Manchineel tree; and the loxia or gross beak of the Bahamas on the fruit of the poison Ash; the leaves of the Kalmia Latifolia are a delicious dainty to the deer, and round horned elk, but fatally destructive to sheep, to horned cattle, and to man.

There is, therefore, more philosophy than meets the eye in the apparently simple remark, that, *what does not poison will fatten;* but, without reference to these more striking anomalies, it will be sufficient to state, that a horse which would be invigorated by corn would feel no appetite for venison;* and this furnishes us with an explanation sufficient to account for the action of many substances which are called poisonous.

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* Dr. Good's Book of Nature.

If we take living matter into the stomach,—and I must beg you will recollect that by living matter I mean that which forms a part of substances, whether animal or vegetable, that have formerly possessed life,—if the stomach have not the power of extracting the living principle, or the matter of life, from them, they having a more powerful affinity will extract the vital principle from the stomach in which it is received.

We cannot doubt that a raw potatoe contains the living principle before it is boiled, but in that state it bids defiance to the operation of our digestive organs; but, when the texture of that substance is broken down by previous culinary process, then the stomach is capable of detaching the living principle from the potatoe, to which it adheres with less tenacity.

The word Poison is a term of very extensive signification, descriptive, not of the ingredient but of the effect; mineral substances, such as Arsenic and Corrosive Sublimate are poisons of the most virulent character, but they produce their effects, not by extracting or extinguishing the living principle, but by producing inflammation, ulceration, or dissolution of the stomach itself; but vegetable narcotics, such as opium, tobacco, henbane, and also prussic acid, act directly upon the vital principle without producing any alteration or destruction in the material structure of the stomach. This theory not only furnishes us with an explanation of many curious facts, but will serve as a regulating principle in the choice of our food.

When a person is exhausted either by hunger or fatigue, when he is in the first state of convalescence from fever or any other lingering disease, the lamp of life, which is an expression at once figurative and philosophical, is so feeble as to be very easily extinguished, and must therefore be fed only with such matter as it is able to consume; it is therefore an error of the first magnitude, and, unfortunately, one which too frequently occurs at the termination of fevers, to give more food, or food of such quality as the stomach is not able to digest.

Numberless instances are to be found, in the records of Medical Science, where persons who have perfectly recovered from the effects of the fever, have brought on a relapse by this intemperate regimen; and, when a relapse is brought on by this means, it almost precludes the hope of amendment, for the body being previously exhausted by disease, there are no powers of reaction and no resources in the constitution.

The late Dr. John Clarke, who was in extensive practice as an accoucheur, published an interesting paper with reference to this subject in the Medical Transactions. He was astonished to find, in three or four instances, ladies who appeared to be doing well after their confinement, and whom he had left well at night, were found dead in the morning. At first he had no suspicion of the cause, till by accident he ascertained that one lady, who had gone to bed in good health, had eaten heartily of oysters ; this led to further enquiry, and, on investigation, it was found that, in all the preceding instances, they had apparently died from the same cause, which the theory that I have now given seems to me sufficient to explain.

In advanced age it is therefore a matter of great importance so to regulate the diet as to make it correspond to the enfeebled state of the digestive organs, for want of which they who possess stamina sufficient to prolong life, if that be a desideratum, to a very advanced period, are frequently and suddenly cut off by this accidental repletion, when there was no other ostensible cause for their dissolution.

In speaking of the matter of life, there are a number of very important facts which I am compelled to reject in order to bring this lecture within a reasonable compass; and at the same time I should be sorry not to say so much as would be sufficient to establish the truth of the doctrine, and I should be glad to know what reasonable objection can be made to the philosophy of the expression.

We speak of the matter of heat and the matter of light—we employ the terms magnetic, galvanic, and electric fluids, and these are terms the propriety of which is ratified by general consent. With regard to heat, philosophers have been careful to point out the distinction between the matter of heat and the sensation of heat; we feel heat, but 'tis the matter of heat that creates the sensation, and exactly the same distinction I wish to make with regard to life and the functions of life, otherwise we confound cause with effect.

A man who is suspended by the neck for an hour is apparently dead, that is to say, all the functions of life are extinguished, and probably can never be restored, but the matter of life is still inherent in the body, the muscles still retain their irritability, as is easily and has been frequently shown by the application of the galvanic stimulus, which is capable of throwing the muscles into violent action, and will sometimes make a person open his eyes, to the no small consternation of the bystanders; but the contractions become less and less, from the repetition of the same stimulus, and the body runs more rapidly into a state of putrefaction.

Putrefaction therefore is nothing more than the disengagement of the living principle, leaving the body from which it has escaped to return to its original elements. This therefore has been one theory of digestion: it has been called a putrefactive process, and the theory is as old as Hippocrates; and, when we consider that the temperature of the human body is favorable to the effect, perhaps the language is more in fault than the conception.

Now what do we know of the natureof the magnetic, galvanic, or electric fluids? we know nothing of them but from their effects, and we have not only the same evidence with regard to the matter of life, but a great deal more. We can take the matter of life, and transfer it from one body to another; we can lock it up in a box for an indefinite length of time, for a hundred years and upwards, and it can then be taken out and made to develope its properties with undiminished activity, or it may be made to jump upon the table: this may appear somewhat ludicrous, but is really not intended as a jest.

The Abbé Fontana, in his valuable work on Poisons, relates several curious facts which will bear me out in what I say: he dried the worm called Seta equina so completely that it lost almost all its weight and bulk, and looked like a bit of dried straw; its skin had shrunk so as to leave no sensible cavity, and life and motion seemed quite extinguished; but the vital principle still remained, it still adhered with unconquerable pertinacity to the body of the insect; for, after being kept for years in this dormant and quiescent state, its activity was almost immediately restored by putting it in water. He made similar experiments with that singular animal the Wheel Polypus, which he exposed during the whole of a very hot summer, on a piece of glass, to the heat of the meridian sun, till it became like a piece of hardened glue; but, on applying a few drops of water, it immediately started into life and activity.

Now, it is impossible to give any assignable limits to the time during which the vital principle may lie dormant, still retaining the power of revivification, probably for centuries, or, perhaps, in æternum.

That some animals are more tenacious of life than others is a well known fact; and, as a general principle, it may be said that their tenacity of life is in the inverse ratio to the complexity of their organization.

I mention these curious facts with a view to substantiate the doctrine that the nutritious principle of all food is the vitality which it imparts, and that the art of cookery does not deprive it of this quality; it only contributes to facilitate digestion, by diminishing the resistance which we should otherwise have to overcome in effecting the separation. I have heard of persons attempting to eat raw meat, in the hope of becoming as bold and as strong as Lions; and *if* they had *but*—(two words which are very annoying when one has a scheme in contemplation)—*if* they had *but* the stomach of a lion, there is no doubt but it would answer very well.

To show how difficult it is, under some circumstances, to dislodge the Vital Principle, I shall merely mention one fact more, which is familiar to every one. The eggs of the Musca Vomitoria, the common Flesh or Blow Fly, are often deposited in the heat of summer upon putrescent meat, and broiled with such meat over a gridiron in the form of steaks, in a heat not merely equal to boiling water, but three or four times greater than that; and yet, instead of being thereby destroyed, we sometimes find them quickened by this exposure into their larvæ or grub.

This inseparable attachment of the principle of life to the germ with which it is identified is the only way by which we can account for the curious, but unquestionable fact, mentioned by Lord Bute and others, that in some boiling springs in Italy, where the temperature of the water was ascertained to be at 212 degrees of Fahrenheit, fish were seen swimming about in all the plenitude of health and vigor. The probability is that, the spawn of the fish not being destroyed by the heat, the development of the vital principle took place under circumstances congenial to its existing peculiarities.

If we turn our attention from Animal to Vegetable productions, we shall find that Nature has been equally provident in protecting the infant germ from the ravages of Time and accidents, and of this we may make a very useful application. The outer skin, or shell, in which the vegetable embryo is enveloped, is evidently constructed for the same wise and important purpose, to bind in the Vital Principle.

I remember the late Lord Stanhope having once said that he had eaten Bread in Switzerland, made from Wheat which had been kept a hundred years, which was perfectly palatable and nutritious. This fact may be worth attending to, in questions of political œconomy; for it has been suggested that, supposing the principles of free trade were generally acceded to, and that other countries had agreed to take our Manufactures in exchange for Corn, we might, in the event of a War with these countries, be subject to great inconvenience by being deprived of such a staple and essential commodity; but when we see how long such food may, by proper management, be preserved, we have it in our own power to guard against the effects of such a contingency. And this policy was probably adopted by the Egyptians, who seem to have been better acquainted with the physical character of Man than any other people with whom History has made us acquainted.

But perhaps the most extraordinary fact on record with regard to the durability of vegetable life, and one we can seldom expect to meet with, occurred some few years ago in the dissection, or rather the examination, of an Egyptian mummy, which had probably been preserved 3000 years, in the hand of which was found a bulbous root; this was put into the ground, and found to vegetate as fresh as if it had been recently transplanted.

By this theory of the matter of life, we see how to account for what is called the dry rot in timber. If timber be cut down in the spring, when the sap begins to move, it will most probably perish from the dry rot; for, though it is separated from the parent trunk, the principle of vegetation is in active operation; it is not what is called seasoned wood, and the following spring the same action revives again; but, even if the wood be dry or seasoned, if it be placed in situations where air and moisture are favorable to the effect, the lurking principle is frequently called into activity, and the dry rot is the consequence. Even in wines a sort of fermentation takes place once a year, and, what is remarkable, it is found to correspond to the season at which the fruit from which it was derived begins to ripen, leading one to suppose that it still retained in some degree the principle of vegetation.

These opinions with regard to the matter of life are not mere idle speculations, but principles that admit of the most useful application. Many ingenious contrivances have already been successfully employed for preserving meat fresh during long voyages, and many more might probably be suggested by a proper attention to these two principles, first, the materiality of life, and, secondly, the peculiar property which carbon possesses of attaching and preserving this material principle.

If you wish to keep Onions, for instance, you have only to apply a red hot iron to the part from which the root issues, that is, to carbonize it, and, by thus preventing the matter of life from making its escape, you keep the Onions for many months longer than could be done if this were neglected.

A great deal has been written by different authors upon the food of plants. Some ascribe it to carbon, others to hydrogen, others to lime, but all these are the mere vehicles of vitality. The food of plants is the same as the food of animals,—it is the vitality which enters into combination with these substances, be they what they may, which constitutes the food of plants.

If you break up virgin soil, and sow it with wheat at a proper season, you will probably have an abundant crop ; the second year you may have a crop of oats or a crop of turnips, if you put in the seeds of either ; but you must not expect another crop of wheat without fresh manure after this, for the fertility of the soil is exhausted, though the carbon remains, and you must either let the land lie fallow for some time, or you must nourish the land, as it is called, by fresh manure.

Now if you manure this land with fish, as has sometimes been done in Holland or some parts of our own coast, when there has been a prodigious glut of herrings, or sprats, or any other fish, you find *that* land will be rendered highly productive for one year only; for, as fish part with their vitality with great rapidity, after that time they have little more nourishment to impart, but, if you manure the land with what the farmers call a solid compost, where straw and other vegetable matter undergo slow decomposition, and consequently part with their vitality very sparingly, a good covering will keep up the fertility of the land for three or four years.

But *lime* is considered to be an excellent thing for improving the land, and it is almost beyond the reach of the imagination to suppose that this substance can possess any thing like the matter of life. That is very true; but then it has a powerful affinity for it. If we want to hasten the putrefactive process of animal substances, we throw on a quantity of quick lime, and this I suppose it will not be necessary to tell any one present is procured by separating it from the carbon with which it was originally united. The common limestone is lime combined with carbonic acid gas; by burning the limestone, the carbon is expelled, leaving that substance called quick lime.

Its value then as a manure depends, not on any nourishment inherent in itself, but on the property which it has of destroying the worms and grubs which feed upon the soil, as well as the quantity of unproductive vegetable matter, as weeds, &c., all which take away a part of the nutritious principle,– it has besides the power of attracting the *materia vita diffusa,* which is contained in the air, or which is brought down by fertilizing showers.

Having now then, Gentlemen, as I presume to hope, said sufficient to show the influence and importance of carbon, oxygen, and vitality, I ought in the next place to show the value of these principles in their application to disease, and especially to that which is now hovering around us, and gradually spreading with unsubdued malignity over the northern part of the kingdom; but I am sure you will agree with me that the time is too short, and the subject too important, to admit of that deliberate attention and minute detail to which it is entitled.

To offer any thing satisfactory on this interesting topic, it ought at least to be the subject of one separate lecture; all that I can do on the present occasion is to submit a few general remarks on its most striking peculiarities,—to draw a broad outline of the disease, and to conduct you as it were to the threshold of the enquiry, without carrying you on to the conclusion; and even this I do with considerable reluctance, not having as yet had an opportunity of acquiring a practical knowledge of the disease: and experience, after all, is the only solid ground on which we can venture to rely.

The Asiatic Cholera, then, is a disease perfectly original and distinct from any other with which we have been previously acquainted, or any one that has been described in the writings of practical Nosologists. It is a disease originating in some peculiar morbid condition of the atmosphere, though what that is, is a question which we are at present unable to determine.

Whether a person affected by atmospheric influence is capable of communicating the disease to another by any effluvia, generated and emanating from his own body, independent of this atmospheric influence—that is to say, whether it be communicated by contagion or not, —is a question that still remains to be decided. I presume to think it cannot, and I will mention one circumstance which I have been made acquainted with since I gave my last lecture, as one proof, among many others upon record, in support of that opinion.

A physician, on whose veracity I can most confidently rely, was in India some years ago, when the Cholera was making its most destructive ravages. "The regiment in which the Cholera broke out was marching from Sàltarah to Poonah; the men were all in good health in the evening when they pitched their tents; the next day, about three o'clock, the first case appeared; in less than half an hour, six or seven more were taken ill, and in less than two hours there were fifteen cases. The regiment, 1200 strong men, moved to a *height* certainly not more than three miles distant; the *infected men were, by his advice, carried in Dhoolies, or native Palanquins,* and though the distance was so short, and the *infected patients were taken with them,* not another case of Cholera afterwards occurred."

The next conclusion at which I have arrived is, that the disease is communicated through the medium of the lungs; that it acts immediately upon the blood, robbing it of its vitality, and not only rendering it unfit for the support of animal life, but incapable of stimulating the heart and arteries to contract, so as to carry on the circulation.

You will recollect I stated that, when the oxygen of the air combined with the venous blood in the lungs, it converted that blood from a dark purple color into a florid red ; the carbon was thrown off in the act of exspiration, the caloric, or matter of heat, combined with the blood, and it returned to the heart "spirited with newness of life."

Now this momentous operation, which we know to be essential to our existence, is evidently suspended, or impeded, by an attack of Cholera ; and the two symptoms that most decidedly warrant the assertion are,—

First—That the blood drawn from the arteries has exhibited all the appearances of venous blood: it has been black agglutinated blood, and instead of flowing *per saltum*, as blood always does from an orifice in an artery, it could scarcely be made to flow at all ; it is clear, then, that this blood had not been oxygenated in passing through the lungs, and, not having its color revived by this oxygenation, the skin, of course, assumed a livid tinge, from the quantity of carbon which had accumulated in the blood.

The Second symptom is—that the body has not the power of generating heat: *the breath is cold,* and *the tongue is cold;* these are two very remarkable symptoms in Asiatic Cholera: in other diseases they are met with at the termination, that is to say, when they terminate fatally; but here they are found at the commencement, which seems to justify the remark of Monsieur Majendie, the celebrated French physiologist, who came over to this country on purpose to witness the symptoms of the disease, "that it begins where other diseases end—*with Death.*"

So far, then, I think I may venture to proceed without straining a hypothesis, that the very essence of the disease is a morbid condition of the blood, owing to some deleterious principle taken into the lungs.

That a cause capable of producing such a change in the state of the blood, without any other organic affection, is sufficient to produce an effect so rapid and destructive, has been repeatedly proved by the most conclusive experiments; it is upon this principle, that savage nations have been induced to poison their arrows, with a view of rendering them more destructive to their enemies; for, though the wound might be slight, the malignity of the poison, introduced into the blood, gave mortality to the dart.

But the most satisfactory proof of the principle is to be met with in the writings of Fontana, whose name I have already mentioned.

Fontana made six thousand experiments with a view to ascertain the effects of the poison of the viper, and the American poison, the Ticunas, upon different animals; he has shown, most indisputably, that the poison operates not upon the stomach, not upon the muscles, not upon the nerves, nor even upon the brain, but wholly and solely upon the blood; that the poison injected into the jugular veins produced death almost immediately, and that the blood assumed exactly the same appearance as it is now found to exhibit in Asiatic Cholera, and as he himself found to be produced by inhaling the Mephitic gases.

But, though he fully satisfied himself that death was occasioned by the action of the poison on the blood, he confesses that he is at a loss to explain the modus operandi; he was aware that it must be by depriving the blood of something very salutary, or imparting to it something very prejudicial: he does not seem to have had a conception of the Matter of Life, which would have solved his difficulties at once.

"In what way," he asks, "are we to account for the immediate action of the venom of the Viper when injected into the veins, and its comparative inactivity when applied to the muscular fibre?" "I must acknowledge," he says, "that this is a very great difficulty." "It is probable," he adds, "that there may be an unknown principle in the Blood, circulating in the vessels, which possesses such active and subtile qualities that it is dissipated the moment the Blood escapes from the vessels; but what is this new principle, and what are the organs which secrete it?"

Here is a close approximation to my Theory, and I should therefore answer his question by saying that, after the food taken into the Stomach is so completely elaborated by the digestive organs as to be converted into Chyle, that Chyle is conveyed into the Blood Vessels, saturated with Vitality, which is to be distributed to every part of the Body, in a degree commensurate to its necessities.

But the Chyle is not completely assimilated with the Blood till it has been submitted to the act of Respiration; and even then, probably, the vitality adheres to it with a slight degree of affinity. Any thing, therefore, whether it be a poison introduced into the Blood Vessels, or some more subtile, but not less malignant principle, introduced into the Lungs, having a greater affinity for the Vital Principle than the Blood itself, will produce all the effects that are found to take place from the bite of a viper in the one case, or the pestilential matter of Asiatic Cholera in the other; and the Blood being deprived of this principle is at once reduced to a certain state of putrefaction,—

Putrefaction being the disengagement of the living principle from the Body to which it is attached.

This is very strikingly exemplified in the effects of the more malignant vipers, as the Cobra de Capello, and the Hæmorrhous Macassarica, where the patient dies in a few minutes after being bitten, and where the Blood has been so rapidly decomposed that it has flown from the eyes, nose, ears, and other parts of the body, previous to the death of the individual.

Life, when that word is employed as synonimous with existence, consists in a series of actions; when these actions are completely suspended death is the consequence: I say completely suspended, or I might have employed a more expressive term had I said extinguished; if there be a spark remaining, there is still a possible chance of resuscitation, as a fire may be rekindled if there be one surviving spark of combustion; so that whilst there is Life there is Hope.

Now, then, applying this reasoning to the phenomena of Asiatic Cholera, it seems to me to explain, in a satisfactory manner, the fatal character of that most singular disease. The Blood being deprived of its vital principle, by some morbid poison floating in the air, it stagnates in the vessels, and runs rapidly into a state of putrefaction.

But, it may be asked, what is that morbific matter contained in the atmosphere, which is capable of producing such deleterious effects when introduced into the Lungs?[*]

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[*] However reluctant the Author feels to introduce what may be regarded as a mere hypothesis, he cannot refrain from mentioning what he conceives to be the essential change in the condition of the atmosphere from which the disease originates, and that he will do in the most concise manner, merely with a view of throwing out a hint on which other physiologists may hereafter improve.

Taking it for granted, then, that we may venture to rely on what Chemistry has taught us to believe, that atmospheric air is composed of oxygen and azote, that the one is essential to the support of Respiration and Combustion, and that the other is unfit for either, he is led to infer, that some change, ascribable perhaps to Electricity, or some other cause, depriving the atmosphere of its due proportion of oxygen, renders that atmosphere unfit for the decarbonization of the Blood, which must produce effects more or less deleterious, according to the circumstances in which the individual may happen to be placed.

If, for instance, his constitution be impaired by poverty, or intemperance, or if he happen to reside in a situation where the putrid effluvia of surrounding exhalations have already rendered him susceptible of disease, such a person can scarcely hope to escape contamination.

Every one must have observed that, previous to a fall of rain, sewers, cesspools, &c., emit a disagreeable effluvia, which may be explained upon this principle, that as water is composed of oxygen and hydrogen, when these airs are about to combine, so as to produce a fall of rain, all bodies, within a given distance, are robbed of their oxygen; and the human body is likewise influenced by the same cause, modified, however, in its effect by peculiarities of constitution; and hence

This is a question, to which I believe it is impossible, in the present state of our knowledge, to give any satisfactory answer, nothing beyond

many nervous and delicate persons complain of languor and lassitude, when such a change is about to take place.

I could mention many instances which have come within the sphere of my own observation, long before Asiatic Cholera was thought of, where the Malaria of particular situations has been equally fatal and malignant. I shall mention one which may be considered instar omnium.

About thirty years ago, when I was a student at the Borough Hospitals, the late Dr. Haighton had a house near St. Saviour's Church-yard for Lying-in Women, and at one time, about the month of August, a sort of epidemic, which would at present undoubtedly have come under the denomination of Asiatic Cholera, proved fatal to all the women who were admitted. Ventilation, fumigation, and purifications, were tried without any good effect, so that the Doctor deemed it adviseable to shut up the house.

Fifteen years after this, I happened to be going by this house, and, what is rather singular, met Mr. Charles Pearson, the present President of the City Board of Health, who perfectly well recollects the coincidence of circumstances, to whom I then communicated what had occurred, and to whom I pointed out what appeared to me quite sufficient to account for the mortality I had witnessed.

The house I allude to was situated close to the Thames, which washed the wall of the house when the tide came in, but after it receded a large quantity of mud was exposed to the action of the sun's rays, and this, as it was a sort of Creek in the River, was the receptacle of dead dogs, cats, and the offals of the Borough Market. Here, then, was a cause adequate vague and uncertain hypothesis; and between theory and hypothesis you must allow me to make a very decided distinction. Theory is the legitimate offspring of reason and reflection, but hypothesis is the mere phantom of imagination: it has no data to reason from, no substratum to rest upon, and can at best only claim the merit of ingenious fabrication; no rational mind would adhere to a theory that would not stand the test of experiment, or would reject the proof of experiment because it is repugnant to his theory. The Theories I have advanced, with regard to Carbon and Vitality, appear to me to be entitled to attention, inasmuch as they will be found to explain all the various phenomena of the living world.

But I have merely given the broad outlines of the subject. I have taken the vitality from the food, and conveyed it to the Blood,* what

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to the effect; and I feel astonished that Dr. Haighton, who was certainly a man of learning and abilities, had never entertained a suspicion of what I am fully persuaded was the cause of all the mortality that occurred.

* No one, I should suppose, will be led to identify the opinions I have advanced on the Matter of Life with John Hunter's doctrine that the Blood is alive. The expression proves

may be its ulterior operation, in the functions of the animal œconomy, is a subject which I cannot attempt to explore, as it would lead to enquiries,

that Mr. Hunter participated in the error which I have previously condemned, that of confounding the Matter of Life with the Functions of Life; the wonder is, that he was not led, by a very natural transition of thought, to ask what made the Blood alive?

No! if I must concede the priority of the doctrine, which, by the way, I have not the least solicitude to maintain, I must revert to much higher authority—higher in the records of time, and higher in the authenticity of its doctrines: I must refer to the oldest document in existence, where I find Moses positively asserts that in the Blood is the Life, a fact which he deems so conclusive and important as to make it the basis of a portion of the Ritual Law of the Jews. And, perhaps, I may be excused for extending the quotation from this Divine Legislator, as being perfectly in accordance with the philosophy of modern science.

He says (Gen. ii. 7), "God breathed into his (Man's) nostrils the breath of Life, and man became a living soul." Now, observe, not the Life, but the Breath of Life, and Man became not a Soul, but a living Soul; so that here is a marked distinction between the Life and the Breath which sustains it, as well as between the Soul and those manifestations of its existence which are observable in the living body.

I should be sorry to say any thing to the disparagement of Mr. Hunter's abilities, but, in our admiration of great characters, we must not renounce the use of our own understanding, or suppose that the ipse dixit of any man is equivalent to proof; indeed, we often see instances of persons possessing very great talents, who, presuming probably on the influence of which it would be difficult to abridge, on the *Moral and Physical character of Man*, which I intend, at some future period, to make the subject of a course of Lectures.

Still it may be asked, and I can readily anticipate the question, What is this Matter of Life, and from what source does it originate?

To this I will venture to reply,

Is there any thing incredible or inconceivable, any thing repugnant to reason or Revelation, in supposing that it is an emanation from Deity itself, that that Spirit which first moved upon the face of the Waters, when there was no light, is the pervading principle that animates the mighty and majestic machinery of the Animal and Vegetable world, imparting to each as much as

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their reputation, have advanced absurdities perfectly incompatible with the reputation they have acquired.

We find the great Haller, whose gigantic mind excites our astonishment, attempting to explain the laws of irritability, by the *vis insita* in muscles; Blumenbach attributing organic operations to a *Nisus formativus*, and John Hunter ascribing the Functions of Animal Life to the stimulus—of what might one suppose?—Why, the *Stimulus of Necessity*. Would any one have thought it possible that men of such transcendent abilities could have felt satisfied with such unmeaning expressions?

may be deemed necessary to accomplish his wise and beneficent designs?

This grand conception of his universal presence is in perfect accordance with the Attributes of God; without his enlivening Spirit the Earth would be without form and void, Creation would be rendered desolate, and chaos return again.

He imparts to Plants, the powers of growth and vegetation; to Animals, instinct and activity, to Man, reason and intelligence; and, "binding Nature fast in Fate, left free the human will:" but Reason, great as is the privilege, is but an uncertain guide in our imperfect condition; it is but what the Poet has described it:—

> The feeble Lamp of Light to man,
> That winks and wakes by turns,
> Fooling the follower betwixt shade
> And shining.

But it is sufficient to elevate our conceptions above the perishable objects of Life's little day. It is sufficient to convince us that he who has implanted in the heart of man the principle of eternal hope, will not frustrate his views by the mockery of disappointment, or "bid him, though doomed to perish, hope to live." It will be sufficient to convince him that the time must speedily arrive when all the pomp and glory of the world will vanish like the fabric of a vision, when all that is temporal must end, and all that is eternal will begin; when Man will see the divinity of his feeble origin confirmed by the sublimity of his expanding views, when he will associate with celestial intelligences, and fix his habitation in the skies.

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